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A KEY TO THE MICROFILARIAE OF THE GENUS *LITOMOSOIDES* (PHYLUM NEMATODA), ENDOPARASITES FROM COLOMBIAN BATS

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Resumen
Se presenta una clave para la identificación de las microfilarias de ocho especies de *Litomosoides* (Filarioidea: Onchocercidae) encontrados en la sangre de 85 murciélagos colombianos. Se reportan once nuevos hospederos de Colombia para *L.brasiliensis, L. caliensis, L. colombiensis, L. guiterasi y L. molossi.*

Palabras clave: Colombia, *Litomosoides,* Microfilarias, Murciélagos, Nemátodos.

Abstract
A key is provided for the identification of eight species of microfilariae of *Litomosoides* (Filarioidea: Onchocercidae) found in the blood of 85 Colombian bats. Eleven new host records for Colombia are reported for *L. brasiliensis, L. caliensis, L. colombiensis, L. guiterasi* and *L. molossi.*

Key words: Bats, Colombia, *Litomosoides,* Microfilarias, Nematodes.

Introduction

Filarial worms inhabit extraintestinal tissues or body cavities of vertebrate hosts, and are often difficult to locate. Adult females excrete embryos which uncoil and are known as microfilariae (Mf). All Mf must develop in a specific blood or lymph-sucking arthropod vector. In appropriate vectors the Mf metamorphose into first, second and third larval stages. The infective third stage larvae migrate to the salivary glands of the vector and are injected into the final host's skin when the vector takes its next blood meal.

The filarial genus *Litomosoides* Chandler 1931 (Filariodea: Onchocercidae) infects only bats and rodents (*Oryzomys, Proechimys, Sigmodon)* in the Western Hemisphere; its vector is unknown but mites have been infected experimentally (Anderson 1992), and no pathogenic effect on the host has been described. The Mf may be confused with other nematodes found in the blood. Esslinger (1973) studied the genus *Litomosoides* in Colombian bats and described or redescribed seven species in great detail. However, he often used pooled blood from a large number of bats for their description, thus he could not study the incidence of the Mf.

Cuartas & Muñoz (1999) reported new host reports for adult worms of *L. artibei* in *Artibeus lituratus, L. brasiliensis* in *Anoura caudifera* and *A. geoffroyi* and *L. guiterasi* in *Lonchophylla robusta*. They also found in the abdominal cavity adults of *Litomosoides caliensis* in *Sturnira lilium, L. chandleri* in *Artibeus jamaicensis, L. guiterasi* in *A. jamaicensis* and *Glossophaga soricina* and *Lonchophylla robusta* and *Litomosoides teshi* in *Carollia perspicillata*. However, they did not assay for Mf. Given that the lack of studies of incidence of Mf is due in part to difficulties of identification, our purpose in this paper is to produce a practical key to the Mf of *Litomosoides* present in the blood of common Colombian bats.

Materials and methods

All bats were collected with mist nets suspended between trees, and were transported alive to Bogotá for examination. Blood obtained from 1030 bats by cardiac puncture was concentrated by Knott's method as described previously (Marinkelle & German 1970); 0.2 ml of blood were added to an equal amount of 1% aqueous solution of formol and centrifuged for 4 minutes at 500 *g*. The sediment was examined for Mf and was smeared on slides, air dried, ethanol fixed and stained with hematoxylin-eosin and 10% Giemsa solution. Only well stained Mf were studied. Measurements were made by means of a calibrated ocular micrometer. To facilitate rapid identification, a simple key was prepared.

Results

All Mf were easily identified using the key. The typical shape of the Mf (fig. 1) could only be observed when the blood had been concentrated by Knott's technique. Parasitemia was always low and 19 out of 40 bat species harbored Mf of the eight species of *Litomosoides (L. artibei* Esslinger 1973; *L. brasiliensis* Lins de Almeida 1936; *L. caliensis* Esslinger 1973; *L. chandleri* Esslinger 1973; *L. colombiensis* Esslinger 1973; *L. guiterasi* (Vigueras 1934) Sandground 1934; *L. molossi* Esslinger 1973; *L. teshi* Esslinger 1973) previously recorded by Esslinger (1973) and Cuartas & Muñoz (1999) from Colombian bats (Table 1).

All well-stained Mf could be identified using only a few the characteristics mentioned by Esslinger (1973). Some small differences in measurements were found. Only 30 to 40% of the observed Mf were well stained and in an optimal position, allowing observation of all the necessary details.

A Key to the Microfilariae of *Litomosoides* in blood from Colombian bats

All measurements are of total length in micrometers (µm); the arithmetical mean is given in brackets.

1. Mf shorter than 80 2

1'. Mf larger than 80 4

2. Tail curved at tip; terminal nucleus ovoid or spheroid and slightly larger then the other nuclei .... *L. chandleri*

2'. Tail not curved 3

3. Body fusiform, widest in the middle; 2 terminal nuclei pyriform, body length 45 to 58 (52) .... *L. guiterasi*

3'. Body not fusiform; 3 to 4 terminal nuclei round, not reaching tip of tail; nuclei anterior to nerve ring often touching each other, body length 53 to 65 (60) .... *L. caliensis*

4. Tail not filamentous with round tip, S-shaped, double flexed; terminal nucleus pyriform, touching tip of tail; body length 97 to 108 (102) .... *L. artibei*

4'. Tail filamentous with pointed tip 5

5. Terminal mucleus round; 2 or 3 minute granule-like nuclei not touching tip. Body length 75 to 109 (96) .... *L. teshi*

5'. Terminal nucleus elongated 6

6. Terminal nuclei 3 to 5, nearly touching each other; terminal nucleus reaching tip of tail, body length 85 to 102 (92) .... *L. molossi*

6'. Terminal nuclei 1 or 2 7

7. Tail abruptly narrowed beyond the anal pore, one terminal nucleus is four times longer than the diameter of the other nuclei and sometimes constricted in the middle; body length 100 to 125 (115) .... *L. colombiensis*

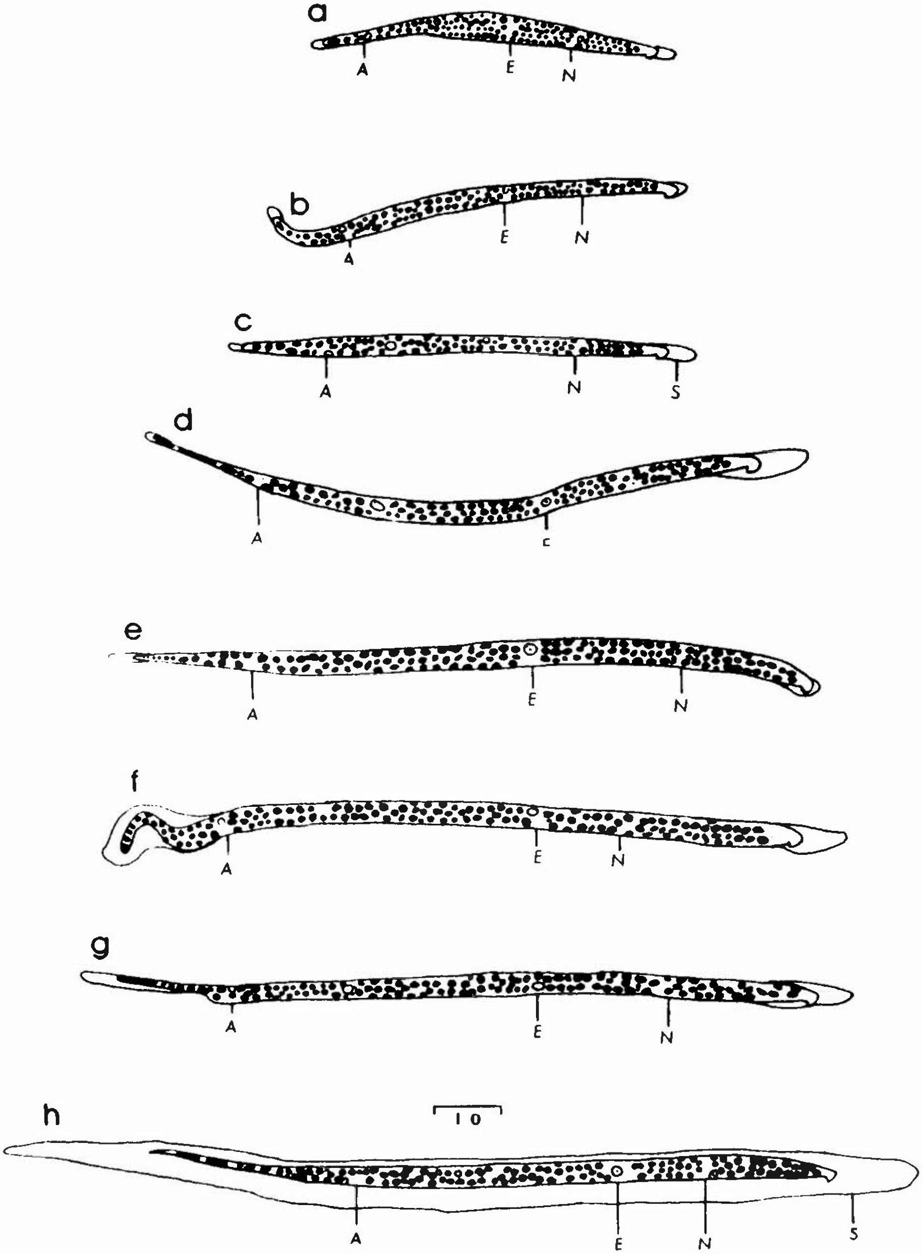
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Figure 1. Camera lucida drawings of microfilariae of species of *Litosomoides* (bar is 10 micrometers). a. *L. guiterasi*, b. *L. chandleri*, c. *L. caliensis*, d. *L. molossi*, e. *L. teshi*, f. *L. artibei*, g. *L. colombiensis*, h. *L. brasiliensis*. A: anal pore, E: excretory cell, N: nerve ring, S: sheet.

Table 1. Incidence of microfilariae (Mf) of *Litomosoides* in the blood of bats from Colombia.

Family and species of bats	**Number of bats examined**	**Number of bats with Mf**	**Collection sites of bats**^{2}	**Mf identified**	**Total number of Mf**^{2}
EMBALLONURIDAE					
Peropteryx macrotis	40	0	III, IX		
NOCTILIONIDAE					
Noctilio leporinus	20	0	I		
MORMOOPIDAE					
Mormoops megalophylla	40	0	III, IV, XII		
Pteronotus parnelli	40	0	III, IX		
P. personatus	40	0	III		
P. gymnonotus	40	0	III		
PHYLLOSTOMIDAE					
Phyllostomus discolor	40	5	XIV	*L. brasiliensis*	30
P. elongatus	20	5	V	*L. brasiliensis*	12
P. hastatus	42	10	II, VI, VII	*L. brasiliensis*	31
Glossophaga soricina	50	5	VII, X, XII	*L. guiterasi*	14
G. longirostris	32	5	II,III	*L. guiterasi*	20
Anoura geoffroyi	24	4	II	*L. guiterasi*	14
Carollia castanea	40	3	XIII, XV	*L. brasiliensis*	6
C. Perspicillata	40	4	VIII, X, XII	*L. brasiliensis*	10
		2	X	*L. teshi*	6
Sturnira lilium	38	4	X, XIII	*L. caliensis*	12
S. tildae	24	2	X	*L. caliensis*	8
Uroderma bilobatum	40	0	XI, XIII		
Platyrrhinus helleri	32	6	XI, XII, XIII	*L. colombiensis*	8
P. dorsalis	30	6	X	*L. colombiensis*	12

Family and species of bats	Number of bats examined	Number of bats with Mf	Collection sites of bats[1]	Mf identified	Total number of Mf[2]
Artibeus cinereus	22	5	X, XIV	*L. artibei*	16
A.jamaicensis	40	4	I, V, X	*L. chandleri*	17
A.lituratus	40	4	I, V, XI	*L. artibei*	22
Desmodus rotundus	50	0	I, III, IV, XII		
NATALIDAE					
Natalus tumidirostris	52	0	XII		
VESPERTILIONIDAE					
Myotis nigricans	42	2	X, XII, XIII	*L. molossi*	20
MOLOSSIDAE					
Eumops perotis	22	2	X	*L. molossi*	8
Molossus molossus	50	4	X, XII, XIII	*L. molossi*	15
M. bondae	40	3	V, XIV	*L. molossi*	22
TOTALS	1030	85			303

1. For collection sites DEPARTMENT, Municipality and (where applicable) local district (vereda) are given, followed by elevation above sea level in meters: I. AMAZONAS, Leticia, 82 m; II. ANTIOQUIA, Puerto Nare, 131 m; III. BOLIVAR, Cartagena, 1 m; IV. BOYACA, Miraflores, 1523 m; V. CAQUETA, Solano, Tres Esquinas, 300 m; VI. CESAR, Curumaní, 33 m; VII. CHOCO, Bahía Solano, 34 m; VIII. CUNDINAMARCA, Pandi, 925 m; IX. GUAJIRA, Manaure, 3 m; X. META, Restrepo, 488 m; XI. NORTE DE SANTANDER, Tibú, Petrólea, 75 m; XII. SANTANDER, San Gil, 1117 m; XIII. TOLIMA, Espinal, 323 m; XIV. VALLE DEL CAUCA, Palmira, 1003 m; XV. VAUPES, Mitú, Durania, 175 m.
2. Number of well stained Mf studied

7'. Tail not abruptly narrowed beyond the anal pore, two terminal nuclei, their length twice their width and not touching the tip of the tail; body length 81 to 104 (92)..*L. brasiliensis*

New hosts records for Mf are *L. brasiliensis* for *Carollia castanea, Phyllostomus discolor, P. elongatus* and *P. hastatus*; *L. guiterasi* for *Anoura geoffroyi* and *Glossophaga longirostris*; *L. caliensis* for *Sturnira tildae*; *L. colombiensis* for *Platyrrhinus helleri* and *L. molossi* for *Eumops perotis, Molossus bondae* and *Myotis nigricans*.

Discussion

L. artibei from *Artibeus cinereus* and *L. colombiensis* from *A. jamaicensis* were reported by Esslinger (1973) from Colombia, but were not found in these hosts during the present study nor by Cuartas y Muñoz (1999). These authors recovered adults of *L. artibei* from *Artibeus lituratus* but they did not examine the bats for Mf.

Additional host records of *Litomosoides* from bats from other countries are: *L. brasiliensis* from *G. soricina* in Brazil (Rego 1961), *Myotis* sp. in Brazil (Lins de Almeida 1936) and *Phyllostomus* sp. in Venezuela (Díaz-Ungría 1963); *L. guiterasi* from *G. soricina* in Brazil (Sandground 1934) and Mexico (Chitwood 1938), *Nyctonomops laticauda* and *Tadarida brasiliensis* in Cuba (Barus & del Valle 1967), *A. jamaicensis* in Cuba (Barus & del Valle 1967); *L. fosteri* Caballero & Caballero 1947 from *G. soricina* in Panama; *L. leonilavazquezae* Caballero & Caballero 1939 from *Macrotus mexicanus* in Mexico and *Litomosoides* sp. found in *A. jamaicensis* in Mexico (Chitwood 1938).

It appears that a moderate degree of host specificity in bat species has evolved in the genus *Litomosoides*. *L. molossi* was the only species recovered exclusively from vespertilionids and molossids, while *L. guiterasi* and *L. brasiliensis* have been found in both vespertilionid and phyllostomid bats in Cuba (Barus & del Valle 1967) and Brazil (Lins de Almeida 1936), respectively. All the records of adult *Litomosoides* of Cuartas & Muñoz (1999) were from phyllostomid bats (but they did not find *L. molossi*); outside of Colombia, all other records of litosomoids except those cited above also have been exclusively from phyllostomid bats.

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